VANADIUM

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In 2004, vanadium consumption in the United States was 4,050 metric tons (t) of contained vanadium, about a 25% increase from that of 2003, representing the second consecutive year consumption has increased. The United States imported 3,740 t of ferrovanadium (FeV), measured in vanadium (V) content, 1,230 t of vanadium pentoxide (V_2O_5), and 133 t of other oxides and hydroxides of vanadium collectively valued at about $72.8 million. Total imports for consumption of these vanadium materials increased about 109% from those of 2003. The United States exported 285 t of FeV (V content), 598 t of V_2O_5, and 823 t of other oxides and hydroxides of vanadium valued at about $19.7 million. Total exports of these vanadium-bearing materials increased by about 3% from those of 2003.

Vanadium was produced in the United States solely by recovery of vanadium from various industrial waste materials, such as vanadium-bearing iron slag, fly ash, petroleum residues, and spent catalysts. Fewer than 10 firms, primarily in Arkansas, Louisiana, and Texas, processed these materials to produce V_2O_5, FeV, and vanadium metal. Metallurgical applications in which vanadium was used as an alloying element with iron, steel, and titanium remained the dominant end use. Catalysts represent the leading nonmetallurgical use for vanadium.

Although vanadium has many uses, metallurgical applications accounted for about 95% of domestic consumption in 2004. Most vanadium is consumed in the form of FeV, which is used as a means of introducing vanadium into steel in which it provides additional strength and toughness. FeV is available as alloys containing 45% to 50% or 80% vanadium. The 45%-to-50%-grade FeV is produced by the silicothermic reduction of V_2O_5 in slag or other vanadium-containing materials. Most of the 80%-grade FeV is produced by the aluminothermic reduction of V_2O_5 in the presence of steel scrap or by direct reduction in an electric arc furnace.

Vanadium-containing steels can be subdivided into microalloy or low-alloy steels that generally contain less than 0.15% vanadium, and high-alloy steels that contain as much as 5% vanadium. Nonmetallurgical applications include catalysts (the dominant use), ceramics, electronics, and vanadium chemicals.

Legislation and Government Programs

The U.S. Department of Commerce announced final antidumping duties on imports of FeV from China and South Africa in a November 21, 2003, final ruling (Ryan's Notes, 2003b). The U.S. International Trade Commission ruled on December 19, 2003, that FeV imports from China and South Africa would be subject to antidumping duties (Platts Metals Week, 2003). These actions resulted in FeV imports from South Africa decreasing to 0 t in 2004 from 59 t in 2003, while imports from China were limited to 36 t in 2004. A new FeV production facility, owned by Xstrata Plc., came online in Swaziland during 2003, and imports increased to 1,130 t in 2004 from 547 t in 2003.

Production

The major vanadium commodities are aluminum-vanadium master alloys, FeV, vanadium-bearing ash, residues and slag, vanadium chemicals, and V_2O_5 (and other oxides and hydroxides of vanadium). In 2004, companies in the United States produced all of these materials with the exception of vanadium-bearing slag from the manufacture of iron and steel.

Vanadium producer Strategic Minerals Corp. created a new subsidiary company to operate its vanadium business in the United States. The new company, Stratcor Inc., which consolidated functions handled by U.S. Vanadium Corp. and Stratcor Performance Materials Inc., will manage vanadium plants in Hot Springs, LA, and Niagara Falls, NY, as well as sales and marketing from Pittsburgh, PA. The company's other vanadium subsidiary, Vametco Minerals Corp., will keep responsibility for vanadium operations in South Africa (American Metal Market, 2004). The Hot Springs plant has a production capacity of 5,440 metric tons per year (t/yr) (12 million pounds per year) of V_2O_5 (Ryan's Notes, 2003c). The new organizational structure took effect July 1.

CRI Metal Products announced it would close its CS Metals catalyst recovery plant in Convent, LA, if a buyer was not found by yearend. CRI decided to divest service operations related to catalysts in order to focus on making catalysts and selling catalyst-related technology. In November, the company was in discussion with a potential buyer capable of completing necessary plant upgrades. A likely suitor was said to be Gulf Chemical and Metallurgical Corp., which operates a catalyst recycling plant in Freeport, TX. The plant has been beset with technical problems and soft metal prices since it opened in October 2000 (Ryan's Notes, 2004c). At its design capacity, the plant was expected to recover 2,270 t/yr (5 million pounds per year) of V_2O_5, 1,800 t/yr (4 million pounds per year) of molybdenum oxide, and 2,270 t/yr (5 million pounds per year) of nickel from spent catalysts (Ryan's Notes, 2003a).

Metallurg Vanadium (a division of Shieldalloy Metallurgical Corporation) settled the 5-month strike at its Cambridge, OH, ferrovanadium plant on April 14 when it ratified a 3-year contract with United Steel Workers (USW) Local 4836. USW workers walked off the job on December 8, 2003. Replacement workers were hired and continued operations at reduced levels, which caused a spot market shortage of ferrovanadium in the United States. In early April, however, output at the plant was near normal so settlement of the strike was not expected to have a significant effect on the market (Ryan's Notes, 2004e). The Cambridge plant has production capacity of 1,800 t/yr (4 million pounds per year) of FeV containing 42% to 48% vanadium.

Metallurg Inc. sold all its senior discount notes back to its parent company, Metallurg Holdings Inc. Metallurg Holdings also entered into a financing agreement with MHR Institutional Partners II. The agreement replaced the existing credit facility, that otherwise would have expired on October 29, 2004, with Fleet National Bank. The proceeds of this financing would allow Metallurg Holdings to make its interest payments due on July 15, 2004, and January 15, 2005 (Ryan's Notes, 2004d). Metallurg Inc. owns Metallurg Vanadium (Ryan's Notes, 2004b).

Consumption

Metallurgical applications continued to dominate U.S. vanadium use in 2004, accounting for about 95% of reported consumption. Nonmetallurgical applications included catalysts, ceramics, electronics, and vanadium chemicals. The dominant nonmetallurgical use was in catalysts. Based on U.S. Geological Survey (USGS) data, domestic vanadium consumption in 2004 was 4,050 t, an increase of about 25% from that of 2003. The increase reflected increased demand by steel producers and greater imports of FeV from Swaziland that more than offset reduced imports from China and South Africa owing to antidumping duties.

The USGS derived vanadium consumption data from a voluntary survey of domestic consuming companies. For this survey, more than 80 companies were canvassed on a monthly or annual basis. Some industry estimates indicate that actual domestic consumption is much greater than reported consumption.

Prices

In 2004, the price for domestic FeV, as published in Metal Bulletin, ranged from \$6.20 to \$23.00 per pound of contained V compared with \$4.30 to \$6.25 per pound reported in 2003. The price rose from \$6.20 to \$9.00 per pound in January, gradually increased to \$12.50 per pound by the end of March, and dipped to \$10.50 per pound in August and September before rebounding in October. The price spiked to \$23.00 per pound occurred in mid-December. The European FeV price ranged from \$14.70 to \$52.00 per kilogram compared with \$9.70 to \$14.40 per kilogram in 2003. The European price rose to \$22.50 per kilogram from \$14.70 per kilogram in January, rose gradually to about \$28.00 per kilogram in May, dropped to below \$20 per kilogram in August, and rebounded to about \$46.00 per kilogram through November. In December, it spiked to reach its high of \$52.00 per kilogram for the year.

The Metal Bulletin published price for domestic V_2O_5 ranged between \$2.75 and \$9.80 per pound in 2004 compared with \$1.50 to \$2.80 per pound in 2003. The price rose gradually from \$2.75 per pound in January to \$6.00 per pound in June, dropped to below \$5.00 per pound in August, and rose to about \$9.00 per pound by November before it spiked at \$9.80 per pound in December.

World Review

Nearly all the world's supply of vanadium is from primary sources. Five countries recovered vanadium from ores, concentrates, slag, or petroleum residues (table 7). In four of the five countries, the mining and processing of magnetite-bearing ores was an important source of their vanadium production. The leading vanadium-producing nations remained China and South Africa. Japan and the United States were believed to be the only countries to recover significant quantities of vanadium from petroleum residues.

Recycling of vanadium-containing alloys for recovery of vanadium was negligible and involved mainly a small quantity of tool steel. Vanadium's major end use was as an alloying element in iron-, steel-, and titanium-bearing alloys, from which it is lost to slag and not recovered when those metals are recycled. Only small quantities of vanadium were recovered from recycling vanadium-bearing catalysts, and that material was reused to make new catalysts.

Australia.—Xstrata Alloys will permanently close the Windimurra vanadium mine in Western Australia (Ryan's Notes, 2004h). The operation was commissioned in 1999 and was kept operating by an offtake agreement with Glencore International AG, which guaranteed \$3.50 per pound of V_2O_5, for much of Windimurra's output. Windimurra's highest production rate was 5,440 t (12 million pounds) in 2002. The plant was put on care and maintenance in February 2003, upon expiration of the offtake agreement. Xstrata spent \$125 million on Windimurra but could not justify an additional \$36 million investment needed to correct operational problems and to restart the plant.

In May, Precious Metals Australia (PMA) sued Xstrata Plc., its former partner in the Windimurra Mine, over its closure of the Western Australian vanadium mine in May 2004. PMA sought damages and an injunction against Windimurra Pty. Limited and Xstrata (Schweiz) AG (a subsidiary of Xstrata Plc.) in the Supreme Court of New South Wales. PMA, which held a 15% interest in Windimurra, sought a declaration that Xstrata breached its royalty agreement with PMA as a result of closing the mine. In June, the Western Australian government initiated an investigation into Xstrata's decision to permanently close the mine. Members of the Western Australian government, local industry, and unions argued that Xstrata decided to close the plant to bolster global vanadium prices (Metal Bulletin, 2004a).

China.—Chinese vanadium producer Panzhihua Iron & Steel Company reportedly shut down one of its vanadium trioxide furnaces for regular maintenance at the end of October for about 45 days. V_2O_3 can be used as an alternative to V_2O_5 in the production of FeV. Panzhihua, China's leading producer of vanadium, has the capacity to produce 2,800 t/yr of FeV (Metal Bulletin Research, 2004).

Japan.—Alpicom S.A., the FeV sales agent for Russia's Tulachermet Vanadium (Tula), has appointed Green Trading Corp. as its sales agent in Japan. Tula had been selling FeV through several traders. Japan's imports from Russia dropped to 60,000 kilograms (kg) in 2003 from 220,000 kg in 2002. Japan's total imports rose to 4.3 million kilograms (Mkg) in 2003 from 3.2 Mkg in 2002. Green trading will continue Tula's policy of selling directly to end-use customers only (Ryan's Notes, 2004f).

Russia.—Tula (owned by Industrial Metallurgical Holding) stood to gain from the Russian Government decision to abolish the 6.5% export duty on vanadium oxides. Tula sourced its vanadium units from slag supplied by Nizhny Tagil Metallurgical Integrated Works and converted it to V_2O_5 at its Tula operation. This change meant that Tula would not have to pay to send V_2O_5 outside Russia for conversion to FeV (Metal Bulletin, 2004b). Tula reportedly cut production by about 30% in October owing to unexpected maintenance work. Representatives of Tula stated it might be mid-November before they re-enter the FeV spot market. Traders expected these developments to exert further upward pressure on vanadium prices in the coming months (Metal Bulletin Research, 2004).

South Africa.—Xstrata Plc. decided to permanently close its Vantech vanadium mine in South Africa, which had been on care and maintenance since January. Xstrata reached its conclusion after determining the investment required to develop the Steelpoortdrift deposit and evaluating higher ongoing operating costs, the sustained strength of the South African rand, and their view that the current price for vanadium was not sustainable in the long term. Xstrata's South African vanadium production decreased only marginally in 2004 because production at its other mine, Rhovan, reached record levels (Ryan's Notes, 2004g).

Swaziland.—U.S. Government import data showed that imports of FeV from the small southern African country of Swaziland began in June 2003 (Platts Metals Week, 2003). Swazi Vanadium Ltd. (a joint venture between Xstrata South Africa Ltd. and Tibiyo Taka Ngwane) officially opened in May 2003. The Swazi FeV plant is located within the Maloma coal mine premises and has a plant capacity of 2,400 t/yr of FeV. Imports from Swaziland increased to 1,134 t in 2004 from 547 t in 2003 (Yonge Nawe, 2002§[1]).

Current Research and Technology

McKenzie Bay International Ltd. is building an integrated "products for energy" organization based on new vanadium-base electricity storage devices and alternative electrical power generation systems (McKenzie Bay International Ltd., 2003§). McKenzie Bay continued development of the WindStor renewable-energy generation, storage, and distribution system. The WindStor system combines Dermond Inc.'s vertical axis wind turbine, called the WindStor wind turbine (WWT), with vanadium-base batteries and a proprietary system integrator to provide stored electricity to users (McKenzie Bay International Ltd., 2004§). On October 27, the company completed the installation and commissioning of a 100-kilowatt (kW) WWT prototype at the Universite du Quebec en Abitibi-Temiscaminque in Rouyn-Noranda, Quebec, Canada. In November, McKenzie Bay began engineering a 200-kW WWT prototype for deployment in 2005. If the 100-kW and 200-kW prototypes perform as anticipated, the company intends to have WWTs manufactured for commercial introduction.

Outlook

Strong demand for vanadium led to a surge in pricing even though production also increased. Despite the closure of Xstrata's Vantech operation in South Africa, worldwide production grew to an estimated 83,900 t (185 million pounds) of V_2O_5 in 2004, about a 5% increase compared with that of 2003. Demand was exceptionally strong, reaching an estimated 90,700 t (200 million pounds) of V_2O_5, about a 15% increase compared with that of 2003. Surging steel production and a move toward higher strength steels in China coupled with strong demand for high-strength and specialty steel in the United States were the driving forces. Demand outstripped supply in both 2003 and 2004, but the deficit was made up from stocks, which had risen to about 23,000 t (50 million pounds) in 2002 (Ryan's Notes, 2004a).

While the rapid rise in demand from China created local shortages, the capacity to recover vanadium from catalysts, petroleum residues, and slag worldwide was estimated to be about 81,700 t/yr (180 million pounds per year) and primary mines add another 24,500 t/yr (54 million pounds per year) of V_2O_5 capacity. As vanadium is primarily recovered as a byproduct, increased steel production in China and South Africa generated larger quantities of vanadium-bearing slag. Increased consumption of petroleum feed stocks led to the generation of larger quantities of vanadium-bearing residues and vanadium-contaminated catalysts. It is estimated that capacity utilization was 80% for steel slag, 80% for vanadium ore, 82% for oil residues, and 63% for spent catalysts. As a result, increased production from existing resources will be sufficient to meet anticipated world consumption levels for the foreseeable future (Ryan's Notes, 2004a).

The world vanadium reserve base, at more than 38 million metric tons, is sufficient to meet vanadium demand into the next century at the present rate of consumption. This does not account for the increased recovery of vanadium from fly ash, petroleum residues, slag, and spent catalyst that will extend the life of the reserve base significantly.

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TABLE 1

SALIENT VANADIUM STATISTICS[1]

		2000	2001	2002	2003	2004
United States:						
Production, ore and concentrate:						
Recoverable vanadium:[2]		--	--	--	--	--
Quantity	metric tons	--	--	--	--	--
Value	thousand dollars	--	--	--	--	--
Vanadium oxide recovered from ore[3]	metric tons	--	--	--	--	--
Consumption	do.	3,520	3,210	3,080	3,240 r	4,050
Exports:						
Ferrovanadium	do.	172	70	142	424	285
Vanadium pentoxide (anhydride)	do.	653	670	453	791	598
Other oxides and hydroxides of vanadium	do.	100	385	443	438	823
Imports for consumption:						
Ferrovanadium	do.	2,510	2,550	2,520	1,690	3,740
Ore, slag, ash, residues	do.	1,890	1,670	1,870	2,220	9,200
Vanadium pentoxide (anhydride)	do.	902	600	406	679	1,230
Other oxides and hydroxides of vanadium	do.	21	57	66	74	133
Stocks:						
Ferrovanadium	do.	278	239	197	228 r	276
Oxide	do.	5	5	5	6 r	6
Other[4]	do.	20	7	19	16 r	23
World, production from ore, concentrate, slag[5]		40,000 r	41,300 r	45,800 r	40,300 r	40,200

[r]Revised. -- Zero.

[1]Data are rounded to no more than three significant digits. Quantities are contained vanadium.

[2]Recoverable vanadium contained in uranium and vanadium ores and concentrates received at mill, plus vanadium recovered from ferrophosphorous slag derived from domestic phosphate rock.

[3]Produced directly from all domestic ores and ferrophosphorous slag; includes metavanadates.

[4]Consists principally of vanadium-aluminum alloy, small quantities of other vanadium alloys, vanadium metal, and ammonium metavanadate.

[5]Excludes U.S. production.

TABLE 2

U.S. CONSUMPTION OF VANADIUM, BY END USE AND FORM[1]

(Kilograms of contained vanadium)

	2003[r]	2004
End use:		
Steel:		
Carbon	1,030,000	1,300,000
Full alloy	808,000	1,060,000
High-strength low-alloy	938,000	1,160,000
Stainless and heat resisting	69,500	60,000
Tool	143,000	239,000
Total	2,990,000	3,820,000
Cast irons	W	W
Superalloys	13,100	16,600
Alloys (excluding steels and superalloys):		
Welding and alloy hard-facing rods and materials	W	W
Other alloys[2]	W	W
Chemical and ceramic uses:		
Catalysts	W	W
Pigments	W	W
Miscellaneous and unspecified	240,000	215,000
Grand total	3,240,000	4,050,000
Form:		
Ferrovanadium	2,910,000	3,610,000
Oxide	238,000	269,000
Other[3]	93,100	180,000
Total	3,240,000	4,050,000

[r]Revised. W Withheld to avoid disclosing company proprietary data; included with "Miscellaneous and unspecified."

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Includes magnetic alloys.

[3]Consists principally of vanadium-aluminum alloy, small quantities of other vanadium alloys, vanadium metal, and ammonium metavanadate.

TABLE 3

U.S. IMPORTS AND EXPORTS OF ALUMINUM-VANADIUM MASTER ALLOY AND VANADIUM METAL, INCLUDING WASTE AND SCRAP[1]

	Aluminum-vanadium master alloy		Vanadium metal, including waste and scrap	
	Quantity, gross weight (kilograms)	Value	Quantity, gross weight (kilograms)	Value
Imports for consumption:				
2003	232,000	$425,000	186,000	$2,850,000
2004:				
Belgium	--	--	51	4,140
France	19,000	54,100	--	--
Germany	58	2,800	23,400	1,260,000
Russia	--	--	6,910	379,000
Switzerland	68	4,080	283	22,300
United Kingdom	9	5,710	602	42,700
Total	19,100	66,700	31,200	1,710,000
Exports:				
2003	9,590,000	22,800,000	201,000	3,910,000
2004:				
Austria	--	--	951	137,000
Belgium	18,400	434,000	3,000	61,300
Brazil	--	--	2,000	25,600
Canada	2,390,000	6,240,000	143	3,470
Germany	11,800	196,000	16,000	273,000
Hong Kong	6,060	129,000	--	--
India	4,400	32,200	--	--
Israel	7,720	143,000	--	--
Italy	--	--	10	8,990
Japan	76,800	621,000	135,000	3,320,000
Korea, Republic of	8,750	56,100	--	--
Mexico	11,600,000	21,900,000	--	--
Norway	16,800	146,000	--	--
Senegal	--	--	202,000	987,000
Singapore	20,100	107,000	4,380	31,100
Spain	4,560	59,300	--	--
Switzerland	--	--	18	55,200
Taiwan	79,600	365,000	50	8,410
Thailand	86,000	399,000	--	--
United Kingdom	273,000	1,270,000	158,000	2,850,000
Total	14,600,000	32,100,000	522,000	7,760,000

[r]Revised. -- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

Source: U.S. Census Bureau.

TABLE 4

U.S. IMPORTS AND EXPORTS OF FERROVANADIUM, VANADIUM PENTOXIDE (ANHYDRIDE) AND OTHER OXIDES AND HYDROXIDES OF VANADIUM[1]

	Ferrovanadium		Vanadium pentoxide (anhydride)[2]		Other oxides and hydroxides of vanadium	
	Quantity, V content (kilograms)	Value	Quantity, V content (kilograms)	Value	Quantity, V content (kilograms)	Value
Imports for consumption:						
2003	1,690,000	$14,300,000	679,000	$3,610,000	74,300 r	$769,000
2004:						
Austria	283,000	6,070,000	4,730	39,200	12,400	204,000
Brazil	11,000	98,300	--	--	--	--
Canada	433,000	4,600,000	--	--	--	--
China	36,100	55,700	71,500	554,000	--	--
Czech Republic	1,710,000	34,900,000	--	--	--	--
Germany	49,000	755,000	3,120	99,600	100	8,470
India	10,100	115,000	--	--	--	--
Japan	550	10,900	1,000	21,200	--	--
Korea, Republic of	25,000	453,000	--	--	--	--
South Africa	--	--	1,130,000	7,600,000	100,000	1,270,000
Swaziland	1,130,000	14,100,000	--	--	--	--
Taiwan	--	--	26,900	285,000	--	--
Tajikistan	48,400	977,000	--	--	--	--
United Kingdom	--	--	--	--	20,300	165,000
Total	3,740,000	62,100,000	1,230,000	8,600,000	133,000	1,650,000
Exports:						
2003	424,000	5,740,000	791,000	4,720,000	438,000	3,810,000
2004:						
Australia	--	--	3,090	29,300	--	--
Austria	--	--	4,050	139,000	--	--
Argentina	--	--	--	--	--	--
Belgium	--	--	271,000	1,700,000	--	--
Canada	64,300	1,240,000	--	--	426,000	3,880,000
China	131,000	5,280,000	198,000	1,500,000	38,200	418,000
Chile	--	--	--	--	51,100	240,000
France	--	--	--	--	2,440	10,000
Germany	--	--	--	--	6,230	79,200
India	--	--	8,170	77,600	2,730	39,700
Israel	--	--	--	--	1,000	6,120
Italy	133	3,630	32,400	139,000	--	--
Japan	550	20,100	--	--	2,950	31,400
Korea, Republic of	31	7,130	--	--	--	--
Mexico	85,500	2,580,000	10,000	136,000	13,500	76,700
Netherlands	2,740	76,500	54,000	340,000	18,800	254,000
New Zealand	--	--	787	14,100	--	--
Saudi Arabia	--	--	7,530	71,500	--	--
South Africa	--	--	--	--	258,000	1,190,000
Trinidad and Tobago	--	--	7,230	111,000	1,860	10,400
Venezuela	--	--	1,380	13,100	--	--
Total	285,000	9,210,000	598,000	4,270,000	823,000	6,230,000

[r]Revised. -- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]May include catalysts that contain vanadium pentoxide.

Source: U.S. Census Bureau.

TABLE 5

U.S. IMPORTS FOR CONSUMPTION OF VANADIUM-BEARING ASH, RESIDUES, AND SLAG[1]

Material and country	2003 Quantity, V_2O_5 content (kilograms)	2003 Value	2004 Quantity, V_2O_5 content (kilograms)	2004 Value
Ash and residues:				
Canada	2,030,000	$2,540,000	11,000,000	$1,920,000
Guatemala	--	--	194,000	89,400
Mexico	1,780,000	3,010,000	4,070,000	8,430,000
Netherlands	39,200	69,800	--	--
South Africa	--	--	1,060	4,950
United Kingdom	120,000	143,000	45,100	80,800
Total	3,960,000	5,760,000	15,400,000	10,500,000
Slag, from the manufacture of iron and steel, South Africa[2]	--	--	1,080,000	1,290,000

-- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]As adjusted by the U.S. Geological Survey.

Source: U.S. Census Bureau.

TABLE 6

U.S. IMPORTS FOR CONSUMPTION OF MISCELLANEOUS VANADIUM CHEMICALS[1, 2]

Material and country	2003 Quantity, V content (kilograms)	2003 Value	2004 Quantity, V content (kilograms)	2004 Value
Sulfates:				
China	--	--	500	$19,100
Total	--	--	500	19,100
Vanadates:				
Canada	--	--	12,200	178,000
Germany	10,100	$205,000	10,100	223,000
Japan	384	19,300	675	31,900
South Africa	62,500	678,000	174,000	718,000
Total	72,900	902,000	197,000	1,150,000

-- Zero.

[1]Data are rounded to no more than three significant digits; may not add to totals shown.

[2]Comprises vanadium ore and miscellaneous vanadium chemicals.

Source: U.S. Census Bureau.

TABLE 7

VANADIUM: ESTIMATED WORLD PRODUCTION, BY COUNTRY[1, 2]

(Metric tons of contained vanadium)

Country	2000	2001	2002	2003	2004
Production from ores, concentrates, slag:[3]					
Australia	1,520 r, 4	2,660 r, 4	3,060 r, 4	160 r, 4	-- 4
China[5]	12,000	12,000	13,200	13,200	14,000
Kazakhstan	1,000	1,000	1,000	1,000	1,000
Russia	7,500 r	7,500 r	8,000	5,800 r	8,000
South Africa	18,021 4	18,184 4	20,500 r	20,100 r	17,200
Total	40,000 r	41,300 r	45,800 r	40,300 r	40,200
Production from petroleum residues, ash spent catalysts, Japan[6]	245	245	245	245	245
Grand total	40,300 r	41,600 r	46,000 r	40,500 r	40,400

[r]Revised. -- Zero.

[1]World totals and estimated data are rounded to no more than three significant digits; may not add to totals shown.

[2]In addition to the countries listed, vanadium is also recovered from petroleum residues in Germany and several other European countries, but available information is insufficient to make reliable estimates. Table includes data available through June 7, 2005.

[3]Production in this section is credited to the country that was the origin of the vanadiferous raw material.

[4]Reported figure.

[5]Estimated 40% of vanadium recovered from vanadiferous slag.

[6]Production in this section is credited to the country where the vanadiferous product is extracted; available information is inadequate to permit crediting this output back to the country of origin of the vanadiferous raw material.